NASA SBIR/STTR Technologies

Topic: H6.02

"Radiation-Hardened Memristor-Based Memory for Extreme Environments"

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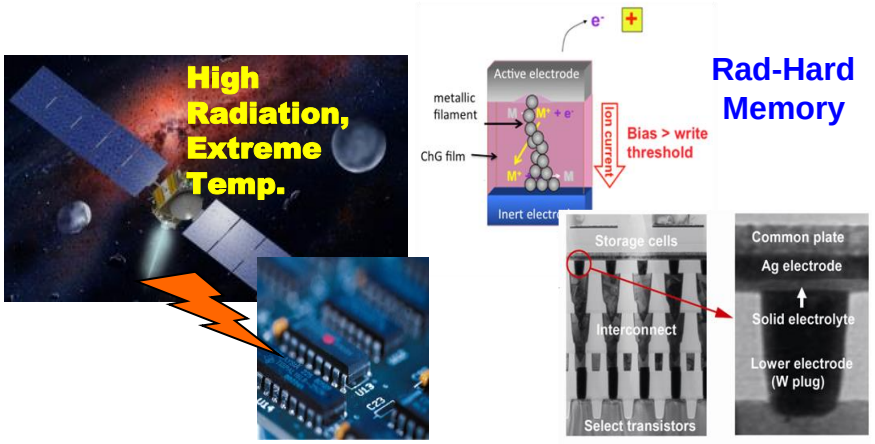
Identification and Significance of Innovation

- NASA space exploration missions need electronics that can survive and operate over a wide temperature range and high radiation levels.
- **Memristors** (*or Resistive RAM*) are a promising technology for next generation, radiation-hardened, non-volatile memory (NVM), offering combination of high density, fast access speed, and low power. Its radiation-hardness makes it a prime candidate for space applications.
- Innovations: **a)** First-ever experimental and simulation-based characterization of memristor technologies, based on chalcogenide-glass and metal-oxide, for extreme environments of deep space (wide-temp. and radiation); **b)** New, multi-scale, physics-based memristor models and design/analysis software.
- **Estimated TRL** at the end of Contract: **4**



Technical Objectives

◆ Evaluate candidate memristor technologies (ChG and metal oxide) for radiation hardness and wide (low) temperature performance. ◆ Develop relevant models and design tools for memristor devices/ circuits in space.

Phase I Results

♦ Fabricated prototypes of ChG-based memristors based on Programmable Metallization Cell (PMC) technology. ♦ Experimentally demonstrated resistive switching of ChG memristors from -230 ºC to +25 ºC – this served as an important proof-of-concept for the applicability of this technology in NASA relevant environments. ♦ Enhanced CFDRC's device physics simulator by adding new 'macroscale' models for device/circuit level (I-V) modeling, and 'atomistic' models for detailed analysis of nanoscale filamentary phenomena (unique achievement) ; ♦ Performed I-V simulations and validated against ASU's measured data. ♦ Identified enhancements required in models/numerics for Phase II work.

NASA and Non-NASA Applications

• **NASA Applications:** Addresses requirements in OCT Technology Area TA11: Modeling, Simulation, Information Technology and Processing Roadmap; Will benefit NASA exploration flight projects, robotic precursors, and technology demonstrators operating beyond low-earth orbit , and all applications that require storage and processing of large amounts of data.

• **Non-NASA Applications**: Novel rad-hard non-volatile memory, threshold logic, and reconfigurable architectures for space applications, such as broadband communication, surveillance, image storage and processing, for future DoD and commercial space systems.

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